Algebra I

Content Standards

2016

Compiled using the Arkansas Mathematics Standards

Course Title: Algebra I
Course/Unit Credit: 1
Course Number: 430000
Teacher Licensure: Please refer to the Course Code Management System (https://adedata.arkansas.gov/ccms/) for the most current licensure codes.
Grades: 9-12

Course Description: The fundamental purpose of this course is to formalize and extend the mathematics that students learned in the middle grades. Because it is built on the middle grades standards, this is a more ambitious version of Algebra I than has generally been offered. The critical areas, called units, deepen and extend understanding of linear and exponential relationships by contrasting them with each other and by applying linear models to data that exhibit a linear trend, and students engage in methods for analyzing, solving, and using quadratic functions.

This document was created to delineate the standards for this course in a format familiar to the educators of Arkansas. For the state-provided Algebra A/B, Algebra I, Geometry A/B, Geometry, and Algebra II documents, the language and structure of the Arkansas Mathematics Standards (AMS) have been maintained. The following information is helpful to correctly read and understand this document.

> "**Standards** define what students should understand and be able to do.
> **Clusters** are groups of related standards. Note that standards from different clusters may sometimes be closely related, because mathematics is a connected subject.
> **Domains** are larger groups of related standards. Standards from different domains may sometimes be closely related." - http://www.corestandards.org/

Standards do not dictate curriculum or teaching methods. For example, just because topic A appears before topic B in the standards for a given grade, it does not necessarily mean that topic A must be taught before topic B. A teacher might prefer to teach topic B before topic A, or might choose to highlight connections by teaching topic A and topic B at the same time. Or, a teacher might prefer to teach a topic of his or her own choosing that leads, as a byproduct, to students reaching the standards for topics A and B.

The standards in this document appear exactly as written in the Arkansas Mathematics Standards (AMS). Italicized portions of the standards offer clarification. The Plus Standards (+) from the Arkansas Mathematics Standards may be incorporated into the curriculum to adequately prepare students for more rigorous courses (e.g., Advanced Placement, International Baccalaureate, or concurrent credit courses).

Algebra I

Domain	Cluster	Course Emphases
The Real Number System		
	1. Use properties of rational and irrational numbers	Additional
Quantities*		
	2. Reason quantitatively and use units to solve problems	Supporting
Seeing Structure in Expressions		
	3. Interpret the structure of expressions	Major
	4. Write expressions in equivalent forms to solve problems	Supporting
Arithmetic with Polynomials and Rational Expressions		
	5. Perform arithmetic operations on polynomials	Major
	6. Understand the relationship between zeros and factors of polynomials	Supporting
	7. Use polynomial identities to solve problems	
	8. Rewrite rational expressions	
Creating Equations*		
	9. Create equations that describe numbers or relationships	Major
Reasoning with Equations and Inequalities		
	10. Understand solving equations as a process of reasoning and explain the reasoning	Major
	11. Solve equations and inequalities in one variable	Major
	12. Solve systems of equations and inequalities graphically	Additional
	13. Solve systems of equations	Major
Interpreting Functions		
	14. Understand the concept of a function and use function notation	Major
	15. Interpret functions that arise in applications in terms of the context	Major
	16. Analyze functions using different representations	Supporting
Building Functions		
	17. Build a function that models a relationship between two quantities	Supporting
	18. Build new functions from existing functions	Additional
Linear, Quadratic, and Exponential Models*		
	19. Construct and compare linear, quadratic, and exponential models and solve problems	Supporting
	20. Interpret expressions for functions in terms of the situation they model	Supporting
Interpreting categorical and quantitative data		
	21. Summarize, represent, and interpret data on a single count or measurement variable	Additional
	22. Summarize, represent, and interpret data on two categorical and quantitative variables	Supporting
	23. Interpret linear models	Major

* *Asterisks identify potential opportunities to integrate content with the modeling practice*

Domain: The Real Number System
Cluster(s): 1. Use properties of rational and irrational numbers

HSN.RN.B.3	1	Explain why • The sum/difference or product/quotient (where defined) of two rational numbers is rational; • The sum/difference of a rational number and an irrational number is irrational; • The product/quotient of a nonzero rational number and an irrational number is irrational; and • The product/quotient of two nonzero rationals is a nonzero rational.	Additional
HSN.RN.B.4	1	• Simplify radical expressions • Perform operations (add, subtract, multiply, and divide) with radical expressions • Rationalize denominators and/or numerators	Additional

Domain: Quantities*
Cluster(s): 2. Reason quantitatively and use units to solve problems

HSN.Q.A.1	2	• Use units as a way to understand problems and to guide the solution of multi-step problems. • Choose and interpret units consistently in formulas. • Choose and interpret the scale and the origin in graphs and data displays.	Supporting
HSN.Q.A.2	2	Define appropriate quantities for the purpose of descriptive modeling. (I.E., Use units appropriate to the problem being solved.) Limitation: This standard will be assessed in Algebra I by ensuring that some modeling tasks (involving Algebra I content or securely held content from grades 6-8) require the student to create a quantity of interest in the situation being described (i.e., a quantity of interest is not selected for the student by the task). For example, in a situation involving data, the student might autonomously decide that a measure of center is a key variable in a situation, and then choose to work with the mean.	Supporting
HSN.Q.A.3	2	Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.	Supporting

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

Domain: Seeing Structure in Expressions
Cluster(s): 3. Interpret the structure of expressions
4. Write expressions in equivalent forms to solve problems

HSA.SSE.A.1	3	Interpret expressions that represent a quantity in terms of its context.* • Interpret parts of an expression using appropriate vocabulary, such as terms, factors, and coefficients. • Interpret complicated expressions by viewing one or more of their parts as a single entity. *For example: Interpret* $P(1 \pm r)^n$ *as the product of P and a factor not depending on P*.	Major
HSA.SSE.A.2	3	Use the structure of an expression to identify ways to rewrite it. *For example: See that (x + 3)(x + 3) is the same as (x + 3)2 OR x4 - y4 as (x2)2 - (y2)2, thus recognizing it as a difference of squares that can be factored as (x2 - y2)(x2 + y2)*. Limitation: i) Tasks are limited to numerical expressions and polynomial expressions in one variable. ii) Examples: Recognize $53^2 - 47^2$ as a difference of squares and see an opportunity to rewrite it in the easier-to-evaluate form $(53 + 47)(53 - 47)$. See an opportunity to rewrite $a^2 + 9a + 14$ as $(a + 7)(a + 2)$.	Major
HSA.SSE.B.3	4	Choose and produce an equivalent form of an expression to reveal and explain properties of the quantity represented by the expression.* • Factor a quadratic expression to reveal the zeros of the function it defines. Complete the square in a quadratic expression to reveal the maximum or minimum value of the function it defines. Note: Students should be able to identify and use various forms of a quadratic expression to solve problems. o Standard Form: $ax + bx + c$ o Factored Form: $a(x - r1)(x - r2)$ o Vertex Form: $a\ (x - h\ ) + k$ Limitation: i) Tasks have a real-world context. As described in the standard, there is an interplay between the mathematical structure of the expression and the structure of the situation such that choosing and producing an equivalent form of the expression reveals something about the situation. ii) Tasks are limited to exponential expressions with integer exponents.	Supporting

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

Domain: Arithmetic with Polynomials and Rational Expressions

Cluster(s): 5. Perform arithmetic operations on polynomials
6. Understand the relationship between zeros and factors of polynomials
7. Use polynomial identities to solve problems
8. Rewrite rational expressions

HSA.APR.A.1	5	• Add, subtract, and multiply polynomials • Understand that polynomials, like the integers, are **closed** under addition, subtraction, and multiplication Note: If p and q are polynomials p + q, p – q, and pq are also polynomials	Major
HSA.APR.B.3	6	• Identify zeros of polynomials (linear, quadratic only) when suitable factorizations are available • Use the zeros to construct a rough graph of the function defined by the polynomial.	Supporting
HSA.APR.C.4	7	Prove polynomial identities and use them to describe numerical relationships. *Note: Examples of Polynomial Identities may include but are not limited to the following:* • $(a + b)^2 = a^2 + 2ab + b^2$ *(Algebra 1)* • $a^2 – b^2 = (a – b)(a + b)$ *(Algebra 1)*	Additional
HSA.APR.D.7	8	• Add, subtract, multiply, and divide by nonzero rational expressions • Understand that rational expressions, like the integers, are closed under addition, subtraction, and multiplication	Additional

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

Domain: Creating Equations*

Cluster(s): 9. Create equations that describe numbers or relationships

HSA.CED.A.1	9	Create equations and inequalities in one variable and use them to solve problems. Note: *Including but not limited to equations arising from:* • *Linear functions* • *Quadratic functions* • *Exponential functions* • *Absolute value functions*	Major
HSA.CED.A.2	9	• Create equations in two or more variables to represent relationships between quantities • Graph equations, in two variables, on a coordinate plane.	Major
HSA.CED.A.3	9	• Represent and interpret constraints by equations or inequalities, and by systems of equations and/or inequalities. • Interpret solutions as viable or nonviable options in a modeling and/or real-world context.	Major
HSA.CED.A.4	9	Rearrange literal equations using the properties of equality.	Major

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

Domain: Reasoning with Equations and Inequalities

Cluster(s): 10. Understand solving equations as a process of reasoning and explain the reasoning
11. Solve equations and inequalities in one variable
12. Solve systems of equations and inequalities graphically
13. Solve systems of equations

HSA.REI.A.1	10	Assuming that equations have a solution, construct a solution and justify the reasoning used. Note: Students are not required to use only one procedure to solve problems nor are they required to show each step of the process. Students should be able to justify their solution in their own words. (Limited to quadratics)	Major
HSA.REI.A.2	10	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise. *For example: The area of a square equals 49 square inches. The length of the side is 7 inches. Although -7 is a solution to the equation, $x^2 = 49$, -7 is an extraneous solution.*	Additional
HSA.REI.B.3	11	Solve linear equations, inequalities and absolute value equations in one variable, including equations with coefficients represented by letters.	Major
HSA.REI.B.4	11	Solve quadratic equations in one variable. • Use the method of completing the square to transform any quadratic equation in *x* into an equation of the form $(x - p)^2 = q$ that has the same solutions. Note: This would be a good opportunity to demonstrate/explore how the quadratic formula is derived. This standard also connects to the transformations of functions and identifying key features of a graph (F-BF3). Introduce this with a leading coefficient of 1 in Algebra I. Finish mastery in Algebra II. • Solve quadratic equations (as appropriate to the initial form of the equation) by: o Inspection of a graph o Taking square roots o Completing the square o Using the quadratic formula o Factoring Recognize complex solutions and write them as $a \pm bi$ for real numbers a and b. (Algebra 2 only) Limitation: i) Tasks do not require students to write solutions for quadratic equations that have roots with nonzero imaginary parts. However, tasks can require the student to recognize cases in which a quadratic equation has no real solutions.	Major

Key:

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		Note, solving a quadratic equation by factoring relies on the connection between zeros and factors of polynomials (cluster A-APR.B). Cluster A-APR.B is formally assessed in Algebra II.	
HSA.REI.C.5	12	• Solve systems of equations in two variables using substitution and elimination. • Understand that the solution to a system of equations will be the same when using substitution and elimination.	Additional
HSA.REI.C.6	12	Solve systems of equations algebraically and graphically. Limitation: i) Tasks have a real-world context. ii) Tasks have hallmarks of modeling as a mathematical practice (less defined tasks, more of the modeling cycle, etc.).	Additional
HSA.REI.C.7	12	Solve systems of equations consisting of linear equations and nonlinear equations in two variables algebraically and graphically. *For example: Find the points of intersection between $y = -3x$ and $y = x^2 + 2$.*	
HSA.REI.D.10	13	Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane.	Major
HSA.REI.D.11	13	Explain why the x-coordinates of the points where the graphs of the equations $y = f(x)$ and $y = g(x)$ intersect are the solutions of the equation $f(x) = g(x)$; Find the solutions approximately by • Using technology to graph the functions • Making tables of values • Finding successive approximations Include cases (but not limited to) where $f(x)$ and/or $g(x)$ are • Linear • Polynomial • Absolute value • Exponential (Introduction in Algebra 1, Mastery in Algebra 2) Teacher notes: Modeling should be applied throughout this standard.	Major
HSA.REI.D.12	13	Solve linear inequalities and systems of linear inequalities in two variables by graphing.	Major

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

Domain: Interpreting Functions

Cluster(s): 14. Understand the concept of a function and use function notation
15. Interpret functions that arise in applications in terms of the context
16. Analyze functions using different representations

HSF.IF.A.1	14	• Understand that a function from one set (called the domain) to another set (called the range) assigns to each element of the domain exactly one element of the range. • Understand that if *f* is a function and x is an element of its domain, then *f(x)* denotes the output of *f* corresponding to the input x. • Understand that the graph of f is the graph of the equation $y = f(x)$.	Major
HSF.IF.A.2	14	In terms of a real-world context: • Use function notation, • Evaluate functions for inputs in their domains, and • Interpret statements that use function notation.	Major
HSF.IF.A.3	14	Recognize that sequences are functions, sometimes defined recursively, whose domain is a subset of the integers. *For example: The Fibonacci sequence is defined recursively by* $f(0) = f(1) = 1$, $f(n + 1) = f(n) +$ $(n - 1)$ *for* $n \geq 1$.	Major
HSF.IF.B.4	15	For a function that models a relationship between two quantities: • Interpret key features of graphs and tables in terms of the quantities, and • Sketch graphs showing key features given a verbal description of the relationship. Note: Key features may include but not limited to: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity.* Limitation: i) Tasks have a real-world context. ii) Tasks are limited to linear functions, quadratic functions, square root functions, cube root functions, piecewise-defined functions (including step functions and absolute value functions), and exponential functions with domains in the integers. Compare note (ii) with standard F-IF.7. The function types listed here are the same as those listed in the Algebra I column for standards F-IF.6 and F-IF.9.	Major
HSF.IF.B.5	15	• Relate the domain of a function to its graph. • Relate the domain of a function to the quantitative relationship it describes. *For example: If the function h(n) gives the number of person-hours it takes to assemble n engines in a factory, then the positive integers would be an appropriate domain for the function.**	Major

Key:

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HSF.IF.B.6	15	• Calculate and interpret the average rate of change of a function (presented algebraically or as a table) over a specified interval. * • Estimate the rate of change from a graph.* Limitation: i) Tasks have a real-world context. ii) Tasks are limited to linear functions, quadratic functions, square root functions, cube root functions, piecewise-defined functions (including step functions and absolute value functions), and exponential functions with domains in the integers. The function types listed here are the same as those listed in the Algebra I column for standards F-IF.4 and F-IF.9.	Major
HSF.IF.C.7	16	Graph functions expressed algebraically and show key features of the graph, with and without technology. • Graph linear and quadratic functions and, when applicable, show intercepts, maxima, and minima. • Graph square root, cube root, and piecewise-defined functions, including step functions and absolute value functions. • Graph exponential functions, showing intercepts and end behavior.	Supporting
HSF.IF.C.8	16	Write expressions for functions in different but equivalent forms to reveal key features of the function. • Use the process of factoring and completing the square in a quadratic function to show zeros, extreme values (vertex), and symmetry of the graph, and interpret these in terms of a context. Note: Connection to A.SSE.B.3b	Supporting
HSF.IF.C.9	16	Compare properties of two functions each represented in a different way (algebraically, graphically, numerically in tables, or by verbal descriptions). Limitation: i) Tasks are limited to linear functions, quadratic functions, square root functions, cube root functions, piecewise-defined functions (including step functions and absolute value functions), and exponential functions with domains in the integers. The function types listed here are the same as those listed in the Algebra I column for standards F-IF.4 and F-IF.6.	Supporting

Key:

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Domain: Building Functions

Cluster(s): 17. Build a function that models a relationship between two quantities
18. Build new functions from existing functions

HSF.BF.A.1	17	Write a function that describes a relationship between two quantities. * • From a context, determine an explicit expression, a recursive process, or steps for calculation. Limitation: i) Tasks have a real-world context. ii) Tasks are limited to linear functions, quadratic functions, and exponential functions with domains in the integers.	Supporting
HSF.BF.B.3	18	• Identify the effect on the graph of replacing $f(x)$ by $f(x) + k, k f(x), f(kx),$ and $f(x + k)$ for specific values of k (k, a constant both positive and negative); • Find the value of k given the graphs of the transformed functions. • Experiment with multiple transformations and illustrate an explanation of the effects on the graph with or without technology. *Include recognizing even and odd functions from their graphs and algebraic expressions for them.* Limitation: i) Identifying the effect on the graph of replacing $f(x)$ by $f(x) + k$, $k f(x)$, $f(kx)$, and $f(x + k)$ for specific values of k (both positive and negative) is limited to linear and quadratic functions. ii) Experimenting with cases and illustrating an explanation of the effects on the graph using technology is limited to linear functions, quadratic functions, square root functions, cube root functions, piecewise-defined functions (including step functions and absolute value functions), and exponential functions with domains in the integers. iii) Tasks do not involve recognizing even and odd functions. The function types listed in note (ii) are the same as those listed in the Algebra I column for standards F-IF.4, F-IF.6, and F-IF.9.	Additional

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

Domain: Linear, Quadratic, and Exponential Models*

Cluster(s): 19. Construct and compare linear, quadratic, and exponential models and solve problems

20. Interpret expressions for functions in terms of the situation they model

HSF.LE.A.1	19	Distinguish between situations that can be modeled with linear functions and with exponential functions. • Show that linear functions grow by equal differences over equal intervals, and that exponential functions grow by equal factors over equal intervals. • Recognize situations in which one quantity changes at a constant rate per unit interval relative to another. • Recognize situations in which a quantity grows or decays by a constant percent rate per unit interval relative to another.	Supporting
HSF.LE.A.2	19	Construct linear and exponential equations, including arithmetic and geometric sequences, • given a graph, • a description of a relationship, or • two input-output pairs (include reading these from a table). Limitation: i) Tasks are limited to constructing linear and exponential functions in simple context (not multi-step).	Supporting
HSF.LE.A.3	19	Observe using graphs and tables that a quantity increasing exponentially eventually exceeds a quantity increasing linearly, quadratically, or any polynomial function. Note: The study of polynomial functions, in general, is reserved for Algebra 2. This standard leads to discussions of relative rates of growth in further coursework.	Supporting
HSF.LE.B.5	20	In terms of a context, interpret the parameters (rates of growth or decay, domain and range restrictions where applicable, etc.) in a function. Limitation: i) Tasks have a real-world context. ii) Exponential functions are limited to those with domains in the integers.	Supporting

Key:

ASM Domain and Standard #	ASM Cluster	ASM Standard	Course Emphases (Category)

Domain: Interpreting categorical and quantitative data

Cluster(s): 21. Summarize, represent, and interpret data on a single count or measurement variable
22. Summarize, represent, and interpret data on two categorical and quantitative variables
23. Interpret linear models

HSS.ID.A.1	21	Represent data with plots on the real number line (dot plots, histograms, and box plots).	Additional
HSS.ID.A.2	21	Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.	Additional
HSS.ID.A.3	21	Interpret differences in shape, center, and spread in the context of the data sets, accounting for possible effects of extreme data points (outliers). *For example: Be able to explain the effects of extremes or outliers on the measures of center and spread.*	Additional
HSS.ID.B.5	22	• Summarize categorical data for two categories in two-way frequency tables. • Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). • Recognize possible associations and trends in the data.	Supporting
HSS.ID.B.6	22	Represent data on two quantitative variables on a scatter plot, and describe how the variables are related. • Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Note: Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models. The focus of Algebra I should be on linear and exponential models while the focus of Algebra II is more on quadratic and exponential models.	Supporting
HSS.ID.C.7	23	Interpret the slope (rate of change) and the intercept (constant term) of a linear model in the context of the data.	Major
HSS.ID.C.8	23	Compute (using technology) and interpret the correlation coefficient of a linear fit.	Major
HSS.ID.C.9	2	Distinguish between correlation and causation.	Major

Key:

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